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THORSTONE BUSINESS MANAGEMENT LIMITED

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COLBY

ISLE OF MAN IM9 4BR

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

ISLE OF MAN

7547336001

4. Title of the invention

COATINGS

5. Name of your agent (if you have one)

GRAHAM F COLES

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Abstract

Drawing(s) 1 + 1

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Coatings

This invention relates to coatings.

- 5 It is known from GB-A-2207089 that powder coatings may be used for bonding two surfaces together by exploiting the melt phase to wet out the surfaces prior to effecting full cure to establish the bond. In normal circumstances, especially when the bond is required
- 10 between sheets or other large-area surfaces, it is found
necessary to employ nip rolling or other pressure-applying means (mechanical or vacuum) to enable a good laminate to be produced. Application of pressure, however, tends to press out the melted powder, and this
- 15 can be of significant disadvantage where the powder is to provide a coloured or opaque coating to a glass or other transparent or translucent substrate. The applied pressure may result in thinning or pressing out of the melt such that on curing there is no solidity and
- 20 uniformity of coating-colour or -opacity and the backing to the coating shows through. It is one of the objects of the present invention to provide a method of bonding by which such problems can be avoided.
- 25 According to one aspect of the present invention there is provided a method of coating wherein materials having different rates of cure are laid down one upon the other while both are substantially uncured, and the coating is formed by a step of curing both while together.
- 30
- According to another aspect of the present invention there is provided a method of bonding two surfaces together wherein the bond is effected using two ~~thermosetting bonding materials that have different cure-~~
- 35 rates, the material of lower cure-rate being applied to the material of higher cure-rate while this latter

material is in the uncured state, prior to curing of both.

5 With this latter method it is readily possible to obtain
a good laminate without the disadvantage of thinning or
pressing out of the melt, and in particular to avoid
show-through where colour or opacity is required with a
transparent or translucent substrate. In the latter
respect, the higher cure-rate material may provide a
10 coating with colour or opacity on a transparent or
translucent substrate and the lower cure-rate material
may be applied to it while the higher cure-rate material
is in its initial un-cured state or at least still not
fully cured. When this latter material hardens to form a
15 solid and uniform coating, the lower cure-rate material
is still in a state to wet the higher cure-rate coating
and the backing surface that is pressed onto it, until
curing is complete. Even if the pressure applied to the
backing to complete the laminate during curing of the
20 lower cure-rate material, presses out that material to be
very thin, the already-cured solid-colour or opaque
coating visible through the substrate, remains
unaffected.

25 The lower and higher cure-rate materials may be
thermosetting powder-coating materials; for example
epoxy, polyester, or acrylic materials. Powder coatings
can be produced with a variety of cure-rate windows so as
to give markedly different rates of cure. The powders
30 are commonly characterised in this regard as 'high-bake'
('low cure-rate') or 'low-bake' ('high cure-rate'); the
terms 'high-bake' and 'low cure-rate' distinguish from
the terms 'low-bake' and 'high cure-rate' in that a
'high-bake' or 'low cure-rate' material takes longer to
35 cure at any given temperature than a 'low-bake' or 'high
cure-rate' material.

Methods of bonding in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings. in which:

- 5 Figure 1 is illustrative of a laminate manufactured according to the method of the invention; and

Figure 2 is illustrative of a door panel manufactured according to the method of the invention.

10

Referring to Figure 1, two coats 1 and 2 of thermally-curing powder are applied one upon the other on a substrate 3. The base coat 1 is a low-bake powder (high cure-rate) and is applied to a surface 4 of the substrate
15 3. While the powder of the coat 1 is still uncured, the second coat 2, which is of a higher-bake cure-window (lower cure-rate), is deposited on it. Heat is then applied to melt both coats 1 and 2, the base coat 1 softening and then hardening first to effect a good bond
20 with the surface 4. The second coat 2 remains wet to ensure good bonding between the cured coat 1 and a backing 5 that is pressed, for example by a nip roller (not shown), onto the coating 2. The applied pressure may press out the melted powder of the coat 2 until
25 curing of the coat 2 is complete, but the first-hardened coat 1 remains substantially unaffected and continuous.

Heat is not applied to melt or cure the low- and high-bake powders until both coats 1 and 2 have been laid down
30 in powder form one upon the other. However, it is preferable to warm the substrate 3 so as to keep the surface 4 free from condensation, but this is not generally intended to affect the condition of the powder
~~deposited on it to any significant extent. The fact that~~
35 one layer of powder is deposited on the other before heat is applied for melting to take place, is believed to improve the bond between the two coats 1 and 2 because of

inevitable intermingling of the powders to some degree, at the interface of the two layers.

5 Thermosetting powders having different cure-rates may be used according to the invention for the straightforward bonding of one item to another, for example as illustrated in Figure 2.

10 Referring to Figure 2, two 'paint' coats 11 and 12 (corresponding to coats 1 and 2 respectively) which are applied to a door panel 13 to protect and give colour to its surface 14, also serve to bond an article such as, in this instance, a door handle 15, to the panel 13. The panel is manufactured by first depositing on the surface
15 14 (electrostatically or by gravity feed) a layer of low-bake powder for the coat 11, and then a layer of high-bake powder on the first powder layer, for the coat 12. Heat is then applied to melt both powder layers and cure the first layer into the coat 11. While the second
20 powder layer is still in the melt phase after the first layer has cured into (or is in an advanced stage towards) the hardened coat 11, the base 16 of the door handle 15 is pressed hard onto the melt and held there until the second layer has cured into the hardened coat 12.

25 The second powder layer acts to wet out the bond between the coat 11 and the base 16 and ensure a firm bond. It may provide a clear, protective covering to the coat 11 which will normally be coloured, and may have afford a
30 gloss or satin finish to the door panel 13.

Resistance to runs and surface imperfections of coatings may be avoided using the method of the invention. The application of first surface colouring, 'painting' is
35 assisted in this process by the ability to apply different colours or thicker coatings in a one-oven line. Conventionally each coat is cured before the application

of a second coat, whereas with the technique of the present invention two or more coats of differing or similar colour and/or clear (possibly gloss) coat may be applied before any curing takes place. The coats are
5 applied as successive powder layers from, for example, separate guns, without any steps being taken to cure one layer before application of the other; once the layers of powder have been deposited, heat is applied to cure them all together in the one step. Each successive powder
10 ~~layer laid down has a slower cure-rate than the one~~
preceding it and this ensures that during the resultant progressive cure, a finish without runs or orange peel effect is achieved. If the final coat is clear gloss, a particularly high quality finish is obtained.

15 The invention may be readily applied to the formation of solid, coloured or clear laminates. In particular, a base material may be coated by the adhesion of another similar or differing flexible material. For example, a
20 laminate may be brought together by tightly winding a foil or plastics element upon a pipe or tube, or if a planar sheet is involved by using a nip roller or press during the cure phase. Low-bake powder is applied to the base component and then re-coated with a higher-bake
25 powder before curing is commenced. When the cure is for example, about 70% complete, the low-bake powder is hard, but the high-bake is still soft to allow foil(s) or plastics element(s) to be applied with good adhesion.

30 A laminate comprising two layers of glass or plastics bonded together to show the same or similar colours viewed from either side, can be manufactured by the application of a fast-curing powder containing
~~pigmentation to one glass or plastics layer and a slow-~~
35 curing powder either on top of that or to the other glass or plastics layer; the slow-cure powder provides a clear coat. Both components are then heated to where the low-

bake powder becomes substantially hard but the high-bake coat is still wet, the two components being nip rolled or pressed together as curing of both coats is completed and the resultant laminate formed.

5

If different colours are to show from the two sides of the laminate, low-bake powder containing a respective pigment is deposited on each glass or plastics component, and high-bake powder on top of one (or possibly both) of the low-bake layers. During curing, the low-bake primary

10

coats on both components cure to hard but are not fully cross-linked (for example about 70% cured) while the high-bake powder is still soft. In this condition the two components are nipped together and then fully cured; the applied pressure enables gas to be pressed from the laminate. The cohering high-bake powder is preferably, though not necessarily, such as to provide a clear coat.

15

20

Although the substrate and other components used in the methods as described above are generally non-porous, the invention is applicable where the components are of a porous nature. In this respect, a primary coat of low-bake powder may be applied to a porous (or other)

25

substrate and after over-coating with a high-bake powder, cured to about 70%. A second component is coated with a high-bake powder and while this coating and the high-bake coating of the first component remain soft, the two components are pressed together for completion of the curing process. The advantage of this method is that the press stage is undertaken when the primary film is continuous and substantially hard so as to ensure that there is no bleed through the porous material from the adhesive layer, during the pressing phase.

30

35

The use of powders with differing cure-rates optimises cross polymerisation of the two coatings; the dual-cure

process enables processing to take place in a perfect gas-free and clean environment right through to full cure.

5 The two coatings may also be two coats of catalyst or ultra-violet curing adhesives with different cure windows. When catalyst adhesives (for example those sold under the trade marks ARALDITE and ARALDITE RAPID) or resins are used, the two cure-rates may be accommodated
10 ~~chemically, allowing for more control of the adhesive~~
layer than hitherto. Conventionally, one-coat application of an adhesive is usually advised. The two components have to be brought together at an early cure time to ensure that the adhesives wet out both surfaces,
15 and then held to full cure, often leading to the bond line being pressed out.

With the method of the present invention, a coat of adhesive is applied to both components, one a fast-cure
20 adhesive and the other a slower-cure adhesive that is formulated to be hard, but not fully cross-linked, when the one is still soft. The faster-cure adhesive delivers a substantially viscose coating that resists the pressure used to bring the surfaces together by nip roller, or
25 press or clamp. The slower-cure adhesive wets out the second surface and offers an optimum bond.

In a process known as the 'Unilam' process, a resin adhesive (such as acrylic, catalyst activated resin) is
30 used for bonding two sheets of glass together. The two glass sheets are held upright spaced apart from one another by a gasket while the resin is poured into the space between them. Although the resulting bond is
~~generally acceptable, the hydraulic pressure of the resin~~
35 tends to bow the sheets apart in the middle, unsatisfactorily. The resulting product has a restricted commercial use because of the variation in gauge caused

by the bowing and the influence this has on the density, and therefore perceived colour, when viewing the laminate.

5 With the present invention, however, these limitations can be eliminated to a substantial extent. In this respect, for example, two plastics or glass sheets used to form the laminate are first coated with resin while laid horizontally. A fast-cure resin is applied to a
10 first of the sheets to form a distancing medium, whilst a slow-cure resin is used to wet out the surface of the second sheet to ensure a good bond with the coating of the first sheet when the two sheets are brought together under a nip roller or press. The resultant laminate is
15 unaffected by the inconsistency-of-gauge problems that currently limit the 'Unilam' products.

As an alternative method according to the invention, primary coats of fast-cure resin are poured onto the
20 surfaces of both glass or plastics sheets while the sheets are retained horizontal on a tilt table. The resin flows out flat on each sheet and begins to cure. As the primary coats begin to harden just beyond the gel stage, the table is tilted to vertical and the two sheets
25 are brought together with the required spacing for the laminate, using an edge gasket. A third layer of resin is then introduced by pouring into the gap between the hardening coats on the two sheets; the sheets are held vertical to degas the resin while pouring takes place.
30 Once the catalysts have substantially cured the primary coats and the poured-resin layer is gelling, the two sheets are returned to the horizontal and the laminate passed through nip rollers squeezing out the poured-layer to give a consistent gauge.

35

Methods in accordance with the invention, using the differential cure-rate technique, may be applied to the

manufacture of solar and other panels where an interlayer is to be inserted, for example, to provide a continuous electrically insulating, conducting or other interface between successive layers of the laminate. By

5 sandwiching aluminium, copper, silicon chips, silicon crystals or other items between low-bake layers, these can then be bonded to outer, substrate layers to make up the laminate, using high-bake material to effect the bond. Similarly, photographic or other images may be
10 inserted into the laminate as a means of decoration,
publicity or other purposes.

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Fig. 1

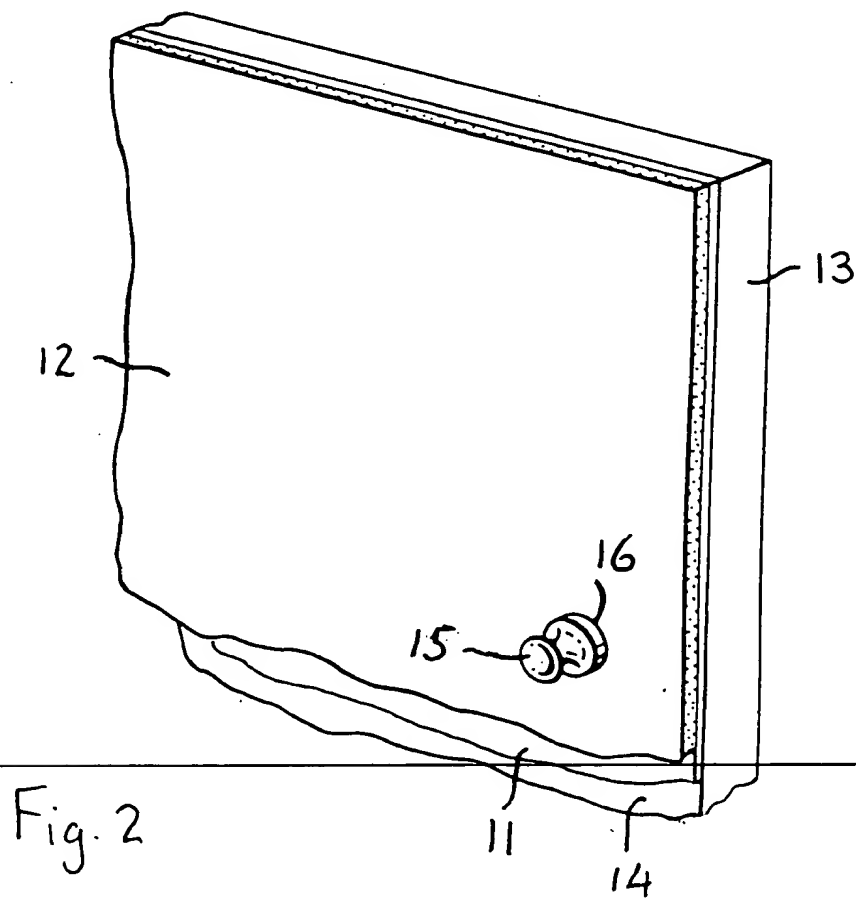
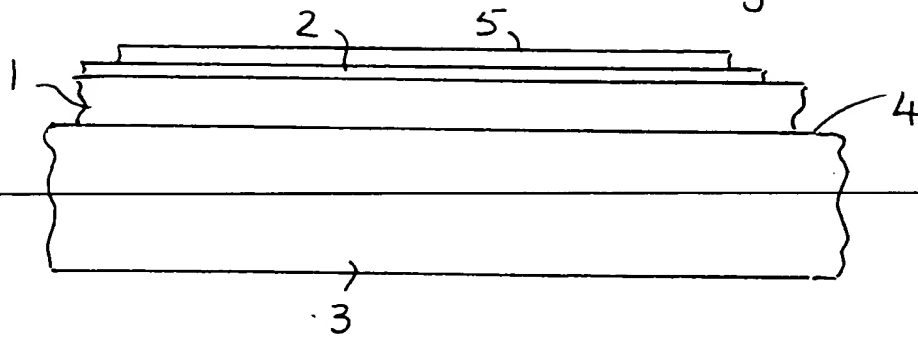


Fig. 2

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